A LONG-LASTING METHOD FOR MARKING BEETLES (COLEOPTERA), WHICH DOES NOT ENHANCE MORTALITY[1]

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ABSTRACT: Mark-release-recapture studies require marking methods that are durable and do not enhance the rate of mortality. Paint from the Mark-Tex Tech-Pen® was used to mark two species of carabid *(Bembidion atrocaeruleum* and *B. decorum),* and an enhanced rate of mortality, due to paint toxicity, was tested for. No significant increase in the mortality was detected over a 37-day period when compared to unmarked beetles. It was concluded that the marking method did not enhance mortality over the period of study.

KEY WORDS: *Bembidion atrocaeruleum, Bembidion decorum,* Coleoptera, Carabidae, exposed riverine sediments (ERS), mark-release-recapture, mark-toxicity.

Mark-release-recapture (MRR) studies, whether for estimating population size or for studying movement dynamics, require methods of marking insects that allow the identification of recaptured individuals. The ideal marking method should satisfy a number of criteria (Southwood and Henderson 2000), which include: (1) the marks must be durable enough to last the duration of study, and (2) the marking method should not affect longevity. Wineriter and Walker (1984) tested the durability of 26 marking materials on the pronota of three species of insect, including the red flour beetle, *Tribolium castaneum* (Herbst). They found that ink extracted from the Mark-Tex Tech-Pen® was the only material sufficiently durable when applied to the flour beetle. Paint from the most modern version of this marker, the TexPen® (ITW Dymon, 805 E, Old 56 Hwy., Olathe, KS 66061), was used in the study of Bates et al. (in press). Despite the abrasive nature of the exposed riverine sediment (ERS, open gravel and sand by the edge of rivers) habitat in which the MRR investigation was implemented, the durability of marks was shown to be sufficient for the period of study (Bates et al. in press). To test the second criterion, that the marking method does not affect longevity, is the subject of this paper.

METHODS

The species from the MRR investigation chosen for the toxicity study were two species of carabid, *Bembidion atrocaeruleum* (Stephens) and *Bembidion decorum* (Zenker in Panzer). These are both relatively small, (4.5-5.5 and 5.6-6 mm, respectively), fast-running, nearly glabrous species, chosen for the study due to their abundance and close association with ERS.

Paint was removed from the pens and diluted at 5:1 (paint : thinner) with turpentine substitute. Beetles were controlled by dropping them into water, from where they could be picked from the surface and held immobile by firmly hold-

[1] Received on September 16, 2004. Accepted October 14, 2004.

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Mailed on November 12, 2004

ing their hind legs between thumb and forefinger. One dot of each of six colors of paint (red, yellow, orange, blue, green and white) were applied, three dots to each elytra, using a piece of 5-amp fuse wire.

Beetles were kept outdoors, in round white polypropylene paint kettles (internal diameter = 172 mm, height 150 mm), which had holes in the bottom to allow drainage and 20-25 mm of sand and gravel substrate in which the beetles could hide and forage. White nylon netting (~0.5 mm diameter) was secured across the top of the container with glue continuously along ~40 percent of the container's circumference and elastic bands for the remainder. This allowed easy access into the containers for feeding and counting purposes. The sediment, which was removed from the MRR site, was initially heated overnight at 140°C in order to kill beetle parasites. The beetles were fed with freeze-dried chironomids as required. The survival of marked beetles of both species was compared with the survival of unmarked beetles over a 36-day period in five replicate containers. Ten beetles were kept in each container and beetles were counted at two- to four-day intervals. Mann-Whitney U (Wilcoxon-Mann-Whitney) tests were used to determine if the number of marked and unmarked beetles surviving at each time period was significantly different.

RESULTS AND DISCUSSION

Figure 1 illustrates the results of the mark toxicity experiment. At almost every time period, for *B. atrocaeruleum* and *B. decorum,* the mean number of marked and unmarked beetles surviving were within 1 standard error of each other and none of the differences were significant at even the 10 percent level. It is concluded therefore that the handling and marking process used did not increase mortality in *B. atrocaeruleum* and *B. decorum* over the period of study. The toxicity experiment was run over a longer time window than those used for the MRR study of Bates et al. (in press), which were <22 days. We therefore conclude that the marking method was likely to have caused no extra mortality in this investigation. It seems highly unlikely that a toxic effect would occur after this 36-day period after marking. The marking method described is a quick, inexpensive method of marking small beetles and other insects, which, for the species tested is sufficiently durable and nontoxic. Given the findings of Wineriter and Walker (1984) it seems likely that the mark longevity on other insects will be longer than for *B. atrocaeruleum* and *B. decorum* when the species are pubescent, or when they live in less abrasive habitats.

ACKNOWLEDGEMENTS

We thank Richard Johnson for all his help and advice. We also thank the department of Geography, Earth and Environmental Sciences at the University of Birmingham, UK, and the Countryside Council of Wales for funding this research.

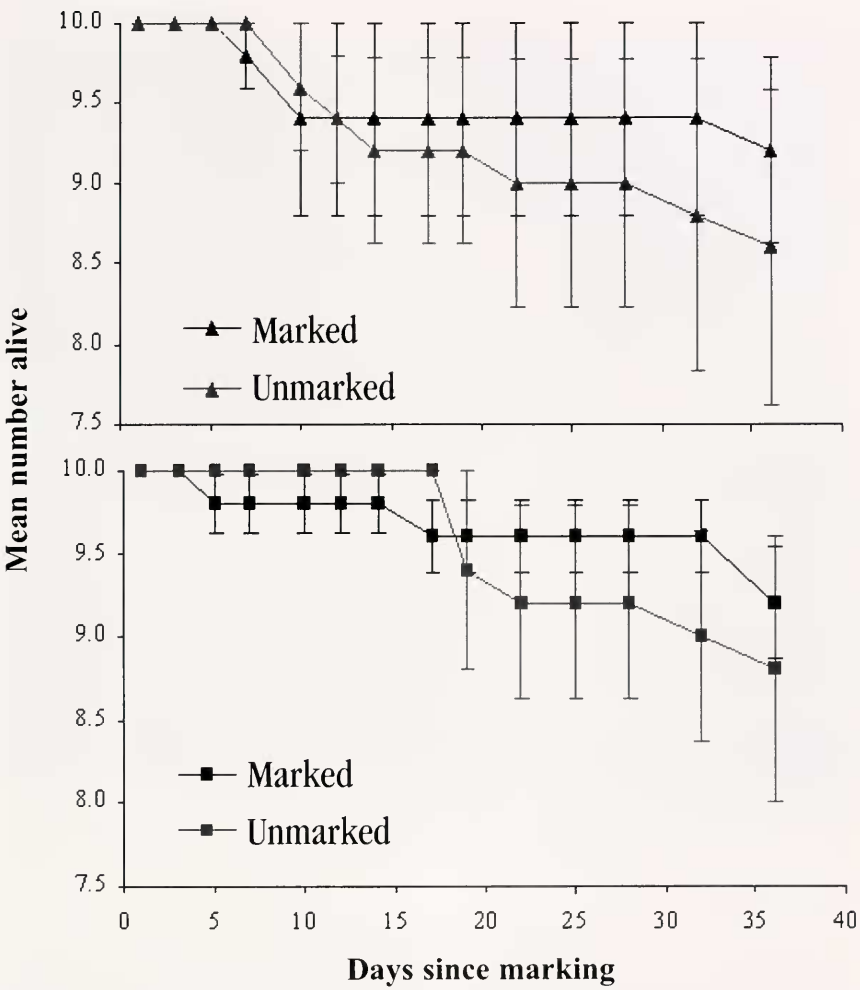

Figure 1. A comparison of the mean number of marked and unmarked *Bembidion decorum* (top, triangles) and *Bembidion atrocaeruleum* (bottom, squares) surviving in replicate ($n = 5$) gravel microcosms (error bars show ± 1 1SE).

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